昆虫学报 *Acta Entomologica Sinica*，December 2005，48(6)：982 – 985 ISSN 0454-6296

Preliminary evaluation of some biparental progenies of two bivoltine silkworm (*Bombyx mori* L.) hybrids

Gulam Nabi MALIK，Syed Zia Ul Haque RUFAIE*，Tejender Paul SINGH，
Mohammed Farooq BAQUAL，Habib Ullah DAR
(Division of Sericulture，Mirgund，Baramulla，Sher-e-Kashmir University of Agricultural Sciences
and Technology，Post Box 674，G.P.O Srinagar，190001，INDIA)

Abstract：Twenty two BIPs (biparental progenies) generated from two bivoltine silkworm (*Bombyx mori* L.) hybrids，viz.，$SH_6 \times NB_4D_2$ and $CSR_2 \times CSR_4$，were evaluated for their performance in seven metric traits (weight of 10 mature larvae，single cocoon weight，single shell weight，shell ratio (%)，effective rate of rearing，yield/10 000 larvae (wt.) and filament length. The experiment was laid out in a completely randomized design (CRD) with three replications for each treatment. The aim was to short list promising progenies and to work out estimates of direct selection parameters like heritability and genetic advance so that the generated information is utilized for the formulation of effective breeding and selection procedures aimed at extraction of new and more productive genotypes. BIPs 2，4，5，6，7，10，14，16，19 and 20 displayed a significantly superior performance in several traits. Single cocoon weight，yield/10 000 larvae (wt.) and filament length exhibited moderate estimates of heritability and reasonable genetic gains indicating genotypic variability to be a major component of phenotypic variability；hence，scope exists to bring about improvement in these traits through simple phenotypic selection. The rest traits (weight of 10 mature larvae，single shell weight，shell ratio (%) and ERR) recorded moderate estimates of heritability and low genetic gains environmental variability to be a major component of phenotypic variability；hence，selection for these traits would be less effective.

Key words：*Bombyx mori*；biparental progenies；heritability；genetic gain

1 INTRODUCTION

The Indian state of Jammu and Kashmir has congenial climatic conditions for uni/bivoltine silkworm rearing. The state has a long history of producing quality uni/bivoltine silk. However，present scenario of this traditional industry is not very encouraging. The number of silkworm rearers in the state decreased from 32 500 in 1985 – 1986 to 23 138 in 2002 – 2003 (Anonymous，2003) as the rearers are finding silkworm rearing as uneconomical avocation and are turning to other economic pursuits. To stop this declining trend and restore past glory of this industry，it is pertinent to evolve cheap cocoon production and protection technologies. Evolution of new and more productive silkworm breeds suited to local agro-climatic conditions and their subsequent commercial exploitation would also contribute not only in boosting cocoon/silk production of the state but also will help in making this avocation economically viable and attractive to overwhelming rural population of the state.

Keeping these objectives in view an attempt was made to evaluate 22 biparental progenies generated from F_2 generation of two commercial hybrids $SH_6 \times NB_4D_2$ and $CSR_2 \times CSR_4$ for some economic traits and to understand nature and magnitude of some direct selection parameters like heritability，genetic advance etc. The generated information may lead to identification of promising progenies and formulation of effective breeding and selection procedures for the isolation of new and more productive silkworm breeds.

2 MATERIALS AND METHODS

Twenty-two biparental progenies (BIPs) were generated from F_2 generation of two commercial bivoltine silkworm hybrids，$SH_6 \times NB_4D_2$ and $CSR_2 \times CSR_4$ by backcrossing F_2 male moths to each of the parental breeds，viz.，SH_6，NB_4D_2，CSR_2 and CSR_4 (the male moths were utilized for second mating after an hour's rest at 5℃). The experimental materials so generated were evaluated in a completely randomized design with 3 replications for each treatment. Each replication comprised 150 worms (after 3rd moult). Rearing was conducted during late summer (August – September)，2004 following the recommendations made by Krishnaswami (1978). The data was recorded in respect of 7 metric traits，viz.，weight of 10 mature

---

* Author for correspondence，Tel：+01951-260256，+0194-2402063，+0194-2402543；Fax：+01951-260256；E-mail：Ziarufaie@yahoo.com

Received：2005-03-24；Accepted：2005-08-25

larvae, single cocoon weight, single shell weight, shell ratio (%), effective rate of rearing (ERR%), yield/10 000 larvae (wt), and filament length. Statistical analysis was done as described by Panse and Sukhatme (1978). Genetic estimates were calculated by following standard methods (Singh and Chaudhary, 1977). Genetic advance was estimated at 5% selection intensity.

3 RESULTS AND ANALYSIS

Mean squares due to progenies were highly significant indicating existence of sufficient variability between progenies. Mean performance of 22 biparental progenies with respect to seven metric traits is presented in Table 1 and described as below.

Table 1 Mean performance of 22 biparental progenies of two silkworm hybrids

BIP no.	$SH_6 \times NB_4D_2$ and $CSR_2 \times CSR_4$						
	Weight of 10 mature larvae	Single cocoon weight (g)	Single shell weight (mg)	Shell ratio (%)	ERR (%)	Yield/10 000 larvae (kg)	Filament length (m)
1	47.87	1.94	35	18.01	96.53*	18.267	818
2	52.38	2.19*	44*	20.09	95.80	22.133*	1 006
3	50.84	1.95	37	18.96	90.13	17.133	865
4	51.91	2.16*	40	18.50	92.73	22.000*	930
5	59.16*	1.98	40	20.20	95.40	20.200	934
6	52.44	2.10*	41	19.52	96.00*	19.800	360
7	54.25	1.98	42	21.21*	97.07*	20.600	1 003
8	52.02	1.92	37	19.26	86.00	18.400	865
9	50.65	2.02	39	19.30	94.73	19.133	916
10	54.07	2.27*	44*	19.35	92.33	20.200	1 030
11	53.21	1.98	40	20.20	91.67	19.133	1 131*
12	51.32	2.01	40	19.89	94.27	18.600	1 000
13	52.03	1.92	36	18.74	95.27	19.600	840
14	52.37	2.04	41	20.10	95.87*	21.467*	839
15	55.63	1.96	37	18.86	94.13	18.267	850
16	57.16*	2.18*	43	19.72	96.47*	22.067*	974
17	52.66	1.92	36	18.71	95.13	20.000	851
18	52.27	1.80	36	19.97	95.27	19.367	635
19	56.56*	2.01	41	20.40	94.60	21.167*	981
20	53.35	2.06	43	21.03*	94.00	19.000	1 015
21	48.27	1.85	39	21.06*	91.33	16.000	1 102*
22	55.65	1.93	38	19.68	95.00	20.000	890
Mean	53.00	2.01	40	19.67	94.08	19.661	932
F test	S	S	S	S	S	S	S
CD (5%)	3.37	8.00	3.28	1.11	1.78	1.189	110.95

* Significant at $P = 0.05$; S: Significant.

Weight of 10 mature larvae: Maximum larval weight of 59.16 g was recorded in BIP 5, followed by BIPs 16, 19, and 22 with weights of 57.16, 56.56 and 55.65 g respectively. BIPs 5, 16 and 19 displayed significantly superior performance vis-a-vis mean (of all progenies).

Single cocoon weight: Highest cocoon weight (2.27 g) was exhibited by BIP 10 and the lowest (1.80 g) by BIP 18. Only five progenies displayed a significantly superior performance when compared with overall mean. These progenies in order of merit were: BIPs 10 (2.27 g), 21 (2.19 g), 16 (2.18 g), 4 (2.16 g) and 6 (2.10 g).

Single shell weight: BIPs 2 and 10 each with a shell weight of 44 mg were the only significant performers in this trait. However, BIPs 6, 7, 14, 16, 19 and 20 registered an above average performance.

Shell ratio (%): Although 12 progenies registered an above mean performance in this trait, yet only three progenies were significant. These were BIPs 7, 21 and 20.

ERR (%): Maximum survival was exhibited by BIP 7 (97.07%), closely followed by BIPs 1 (96.53%), 16 (96.47%), 6 (96.00%) and 14 (95.87%).

Yield/10 000 larvae (wt.): Five progenies displayed a promising performance. These progenies in order of merit were BIP 2 (22.133 kg), 4 (22.000 kg), 14 (21.467 kg) 16 (22.067 kg) and 19 (21.167 kg).

Filament length: BIPs 11 and 21 with filament lengths of 1 131 and 1 102 meters were the most outstanding progenies. However, minimum filament length of 635 meters was recorded in BIP 18.

Difference between PCV and GCV (Table 2) was maximal for filament length followed by single shell weight, weight of 10 mature larvae and shell ratio (%), indicating substantial effect of environment in the manifestation of these traits. The maximum estimate of heritability (bs) was obtained for single cocoon weight (69.55 %) followed by ERR and yield/10 000 larvae (wt.) with values of 69.50% and 65.50% respectively. Least heritability estimate was obtained for shell ratio (%). Moderate estimates of heritability have also been reported by Gosh *et al*. (1994) for cocoon weight and Malik *et al*. (1999) for ERR (%). Contrary to this, high estimates of heritability for cocoon weight and shell weight have been reported by Gamo and Hirabayashi (1983), and Ashoka and Govindan (1990); Rangaiah *et al*. (1995) found shell ratio (84.6%) to be highly heritable followed by shell weight (72.70%). In the present study maximum genetic advance (122.89) was recorded in filament length and minimum for shell ratio (48%). However, in an earlier study Malik *et al*. (1999) obtained maximum genetic advance for shell weight (29.0) followed by cocoon weight (21.1). Maximum genetic advance for shell weight has also been reported by Ashoka and Govindan (1990), Gosh *et al*. (1994) and Rangaiah *et al*. (1995). Diverse reports about magnitude of different genetic parameters are due to difference in the genetic make-up of experimental materials utilized by different workers. In the present study, moderate heritability for single cocoon weight, yield/10 000 larvae and filament length accompanied by reasonable genetic gain of 9.17%, 12.31% and 13.19% respectively suggest that genotypic variability is a major component of phenotypic variability; hence, selection of phenotypically superior individuals from the populations would be effective in improving these traits. The rest traits exhibited low to moderate heritability and low genetic gains, suggesting environmental (non-genetic) variability to be a major component of total (phenotypic) variability; hence, selection for these traits would be less fruitful.

Table 2 Coefficients of variation, heritability and genetic advance for seven traits in biparental progenies of two silkworm hybrids $SH_6 \times NB_4D_2$ and $CSR_2 \times CSR_4$

Traits	Coefficient of variation		Heritability (bs)	Genetic advance	Genetic gain (%)
	Phenotypic (PCV)	Genotypic (GCV)			
Weight of 10 mature larvae	6.84	3.88	32.00	2.39	4.51
Single cocoon weight	6.41	5.34	69.55	18.42	9.17
Single shell weight	9.09	5.46	36.00	2.70	6.75
Shell ratio (%)	5.95	3.22	29.00	0.48	2.44
ERR (%)	3.04	2.53	69.50	4.09	4.35
Yield/10 000 larvae (wt.)	9.13	7.39	65.50	2.42	12.31
Filament length	14.22	9.53	45.00	122.89	13.19

In the present set of materials, BIPs 2, 4, 5, 6, 7, 10, 14, 16, 19 and 20 happen to be promising as these exhibited a significantly superior performance in several metric traits. Hence, scope exists to bring about further improvement in these progenies by resorting to within progeny selection in successive generations.

Acknowledgement The authors are thankful to Mr. Nazir Ahmad Dar (JTA) and other staff members of Silkworm Physiology and Rearing Technology section of the Division for their kind assistance rendered during the course of experiment. Thanks are also due to authorities of Sericulture Development Department, J & K State for supplying disease free seed of CSR2 and CSR4 silkworm races.

References

Anonymous, 2003. Digest of Statistics. Directorate of Economics and Statistics Planning and Development Department, Govt. J. & K. 186 pp.

Ashoka J, Govindan R, 1990. Genetic estimates of quantitative traits in bivoltine silkworm, *Bombyx mori* L. *Mysore Journal of Agricultural Sciences*, 24(3): 371 – 374.

Gamo T, Hirabayashi T, 1983. Genetic analysis of growth rate and pupation rate of some quantitative characters by diallel cross in silkworm *Bombyx mori* L. *Japanese Journal of Breeding*, 33: 191 – 194.

Gosh B, Dass RSK, Nair BP, Chattopadyay S, Sen SK, Sengupta K, 1994. Some genetic parameters in multivoltine silkworm, *Bombyx mori* L. *Entomon*., 19(3, 4): 91 – 93.

Krishanaswami S, 1978. New Technology of Silkworm Rearing. CSR&TI Bull. 2, Publ. Central Silk Board, Bangalore. India. 1 – 23.

Malik GN, Masoodi MA, Kamili AS, Aijaz M, 1999. Estimation of direct selection parameters in diallel set of bivoltine silkworm (*Bombyx mori* L.). *Entomon*., 24(3): 253 – 257.

Panse VG, Sukhatme PV, 1978. Statistical Methods for Agricultural Workers. 3rd ed. ICAR, New Delhi. 347.

Rangaiah S, Govindan R, Devaiah MC, Narayanaswamy TK, 1995. Genetic studies for some quantitative traits among multivoltine races of silkworm *Bombyx mori* L. *Mysore Journal of Agricultural Sciences*., 29(3): 248 – 251.

Singh RK, Chaudhary BD, 1977. Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers Ludhiana, New Delhi, India.

家蚕二化性杂交品种部分数量性状遗传参数的初步评估

Gulam Nabi MALIK，Syed Zia Ul Haque RUFAIE*，Tejender Paul SINGH，
Mohammed Farooq BAQUAL，Habib Ullah DAR
（Division of Sericulture，Mirgund，Baramulla，Sher-e-Kashmir University of Agricultural Sciences
and Technology，Post Box 674，G.P.O Srinagar，190001，INDIA）

摘要：**采用完全随机设计法根据** 10 **头老熟幼虫体重、全茧重、茧层量、茧层率（%）、存活率、万蚕茧层量和茧丝长等指标，对两对二化性家蚕** *Bombyx mori* L. **杂交品系**（$SH_6 \times NB_4D_2$ **和** $CSR_2 \times CSR_4$）**杂交一代的** 22 **个子代个体进行了遗传参数估算，以缩小优质蚕品种的候选范围，并且计算出直接筛选的参数，如遗传力和遗传进度等，使这些信息可用于以筛选高产新品种为目的的育种和选择过程中。杂交子代** 2，4，5，6，7，10，14，16，19 **和** 20 **号个体在这几个指标中表现出显著的优越性。全茧重、万蚕茧层量和茧丝长的遗传力和遗传进度较大，可以简单地从表现型的差异对这些性状进行选择并取得遗传性状改良。其他几个指标（**10 **头老熟幼虫体重、茧层量、茧层率（**%**）和存活率）的遗传力和遗传进度较低，对这些性状进行直接选择来改良品种的效果较差。**

关键词：**家蚕；杂交一代；遗传力；遗传进度**
中图分类号：Q963　　文献标识码：A　　文章编号：0454-6296（2005）06-0982-04

（责任编辑：袁德成）